LANDOWNER PERCEPTION, AWARENESS, AND ADOPTION OF WILDFIRE PROGRAMS IN THE SOUTHERN UNITED STATES

A Thesis

by

ADAM R. JARRETT

Submitted to the Office of Graduate Studies of
Texas A&M University
in partial fulfillment of the requirements for the degree of

MASTER OF SCIENCE

August 2008

Major Subject: Forestry

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Approved by:

Chair of Committee,	Jianbang Gan
Committee Members,	J. Richard Conner
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Head of Department,	Steve Whisenant

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ABSTRACT

Landowner Perception, Awareness, and Adoption of Wildfire Programs
in the Southern United States. (August 2008)
Adam R. Jarrett, B.S., Texas A&M University
Chair of Advisory Committee: Dr. Jianbang Gan

Non-industrial Private Forests (NIPF) landowners constitute a major component of the forested land portfolio in the Southeastern United States. The lands they possess provide a variety of social benefits but many aspects of how these landowners manage their properties exist. The goal of this research was to determine overall landowner awareness regarding wildfire programs and education and identify interrelationships among management strategies, demographic variables, and experiences. Specifically, it was hypothesized that landowner program awareness, interest in biomass utilization, and wildfire mitigation strategies would be influenced by the type of information they received, management activities, and other factors. Seven logit models were constructed to analyze these interrelationships.

Results revealed that the type and quality of information landowners received was important in most cases. Landowners not receiving any information were less likely to take action to prevent or mitigate wildfire damage to their property. Wildfire education was highly valued by participants. Knowledge of existing biomass utilization programs was almost non-existent. However, the desire to obtain information on this

topic was high. In general, state agencies were utilized more than federal agencies, and landowners felt that cost-share programs and marketability of removed biomass would encourage participation in wildfire prevention activities.

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First, I would like to thank my committee chair, Dr. Gan, for his constant support, guidance, and patience while I worked to complete this research. He provided an excellent example of mentorship and helped imbibe me with many of the critical thought processes that I will carry forth into future endeavors. Thanks are also due to my committee members Dr. Conner and Dr. Fan, as well as to the professors and students of the Department of Ecosystem Science and Management at Texas A&M who provided me with criticism and encouragement along the way. I would like to recognize the United States Forest Service and various state agencies as well. Finally, I would like to express gratitude to my family and my fiancé for the support and encouragement they have provided over the last two years.

NOMENCLATURE

DOE – Department of Energy

DSIRE – Database of State Incentives for Renewables and Efficiency

GAO – United States Government Accountability Office

HFI – Healthy Forest Initiative

HFRA – Healthy Forests Restoration Act (2003)

JFSP – Joint Fire Science Program

NFP – National Fire Plan

NIFC - National Interagency Fire Center

NIPF – Non-industrial Private Forests

NWOS – National Woodland Owner Surveys

USDA – United States Department of Agriculture

USDI – United States Department of the Interior

USFS – United States Forest Service

WUI – Wildland-Urban Interface

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CHAPTER I

INTRODUCTION

1.1 Introduction

Each year, wildfires burn across the broad expanses of the United States consuming valuable property, taking lives, and costing individuals and taxpayers hundreds of millions of dollars. In 2005 alone, the National Interagency Fire Center (NIFC) estimated a record 8.7 million acres were affected by wildfires in the U.S. (NIFC 2006). While wildfire is a natural and vital disturbance in many ecosystems, a century old policy of total suppression coupled with widespread apprehension towards fire use have created a nationwide tinderbox that erupts on an annual basis with catastrophic consequences.

Although measures have been initiated to encourage the reduction of these hazardous fuels in recent decades, there is a great deal of variation in program availability on a state-by-state basis. Greater disparity exists among states regarding use of residual biomass that often results from fuel reduction activities. Current for legislation for biomass utilization have often been developed without consideration for wildfire mitigation and other environmental factors. Such a disconnection in policy may act to hinder adoption and effectiveness of these programs.

This thesis follows the style of *Forest Science.*

Government measures such as the Healthy Forests Restoration Act (HFRA), the Energy Policy Act of 2005, and subsequent legislation have recognized both the need by government agencies such as the United States Department of Agriculture (USDA), United States Department of the Interior (USDI), and Department of Energy (DOE) to work together to carry out the objectives of reducing the threat of catastrophic wildfires and expanding the use and viability of biomass based energy products. One component of this cooperation is to develop programs that educate landowners and at risk communities about the dangers of wildfires, reduce hazardous fuels, and encourage the diversification of the U.S. energy portfolio, which includes the use of woody biomass for energy generation. While these objectives, among others, have been laid out and some cooperative measures have commenced, a lack of centralized policy and leadership within these agencies may limit their effectiveness.

Thorough knowledge and understanding of Non-industrial Private Forests (NIPF) landowner attitudes and strategies is a key component for initiating progressive management measures on forest lands from which all members of society receive benefits. While recent studies have attempted to identify the attitudes and perceptions of this sector of society, much remains unknown. Recent changes in fire and energy policies and land management strategies are helping to transform public perception of wildland fire and associated processes that help to reduce hazardous fuels. While further research and improved techniques may be needed before biomass utilization as a fuel source can become a major economic competitor to fossil fuels, biomass derived fuels may also have a smaller net effect of greenhouse emissions and thereby may be more

ecologically friendly. This study will focus on factors that affect landowner knowledge and awareness regarding wildfire, wildfire programs, and hazardous fuel reduction programs. In addition, it will analyze which wildfire mitigation tools landowners utilize and what factors influence their decision.

1.2 Hypotheses and Objectives

The overall objectives of this research are to assess landowners' awareness of state wildfire mitigation programs and to determine what factors influence (a) landowner awareness and education regarding programs associated with wildfire, biomass utilization, and hazardous fuel reduction, and (b) landowners' decisions on wildfire mitigation. Specifically, this study is intended to test the following three major hypotheses:

H1: Landowner knowledge of wildfire education and hazardous fuel mitigation programs is correlated to the type of information they receive, land management activities in which they engage, and various demographic characteristics.

H2: Landowners' interest in obtaining information regarding biomass energy production is influenced by the type of information they receive, the ability to generate income from biomass resources, and various management strategies and practices.

H3: Landowner participation in various wildfire mitigation and management strategies is interrelated to factors that include other management activities and strategies on their rural property, the type of information they receive, program awareness, previous fire history, and demographic characteristics.

Determination of policy and program utilization and effectiveness, including knowledge of the values and management objectives held by NIPF landowners, is integral to formation of future policy. This research will further the goal of improving program effectiveness by providing a representative sample of what state level programs landowners find useful, which management practices they utilize, a demographic portrait of NIPF landowners in the region, and interrelationships that may exist, among factors. This research will also look at what value landowners place on various agencies and informative media, what they consider as the role of the state in fire prevention, and their knowledge of and willingness to participate in biomass utilization, all of which should be important considerations that come into play when policy is being made.

CHAPTER II

LITERATURE REVIEW

2.1 History of Fire Policy in the United States

To understand the situation that currently exists in fire policy better, and to identify the important role policy plays on the health of an ecosystem, it is useful to examine the past. Since about 1900, the United States has effectively enacted a policy of fire suppression on wildlands. The "10 o'clock rule," adopted in the 1930's was a rule of thumb stating that fire fighters should aim to suppress any wildfire by 10 a.m. the morning following ignition. Dale states that over the years, through adequate funding and maintenance of a large number of trained fire personnel, this policy of total fire suppression has been quite successful, resulting in suppression of over 99% of all unwanted wild fire ignitions (Dale 2006).

The success of this policy objective, however, has not been without consequences. NIFC data collected from 1960-2003 indicates a trend of increasing fire frequency and intensity across the United States (Sun 2006). The very act of suppression in ecosystems that have evolved with fire has led to overstocking, buildup of highly flammable biomass, accumulation of litter materials on the forest floor, and an overall decline in forest health due to increased competition and proneness to disease or parasites. The fire danger that now exists in these forests is drastically different from that which resulted when these stands were in their natural, fire maintained state (HFRA 2006). While Dale argues that a deeper analysis of the situation may yield a different

view, one in which societal needs and expectations are strongly reflected in public policy, some researchers point to this as a good example of policy failure due to inability or unwillingness of the government to show elasticity when facing dynamic conditions. "Wildfire Management in the United States: The Evolution of a Policy Failure" by Busenburg (2004) outlines fire policy history in terms of a punctuated equilibrium, where policy is initially set in motion and all future policy is influenced by the principles that govern the original doctrine. Busenburg's theory states that policy is marked by critical periods of change in which institutional viewpoints, definitions, and arrangements of associated agencies are established, and that if the original doctrines and policies are flawed, the ripple effect can be far reaching and negatively affect policy for years (Busenberg 2004). He goes on to point out the origin of these failures began with the decision to focus attention on a single aspect of a multifaceted problem. By developing a policy of fire suppression that was not coupled with a policy geared towards reducing the fuels that would accumulate in the absence of fire, policy makers doomed American wildlands to decades of escalating and increasingly destructive fire events. Land management policy must achieve both a satisfaction of public desires and perceptions, meet the specific goals of government and land managers, and carefully address all aspects of an existing situation to be effective. In contrast to the mainstream policy of fire suppression that was adopted nationally, use of fire as a management tool was culturally accepted in the Southeastern United States, and the first use of prescribed fire took place on federal lands in the Osceola National Forest in 1943 (Stephens and Ruth 2005).

Stimulated by the devastating events of the 1994 fire season, the federal government issued a report in 1995 that produced a comprehensive policy directive for all federal land management agencies. The 1995 Federal Fire Policy recognized for the first time the integral role that fire plays in the maintenance of natural systems (USDI and USDA 1995). This shift in policy to include fire as an essential component in natural ecosystems has significantly impacted management strategy on wildlands since 1995 (Stephens and Ruth 2005). In 2000, ‘‘A Report to the President in Response to the Wildfires of 2000’’ established the National Fire Plan (NFP), which has stated goals of providing adequate firefighting resources, rebuilding devastated communities, investing in projects to reduce hazardous fuels, and working directly with communities, which includes public input on fire policy (USDA and USDI 2000). The ‘‘Collaborative Approach for Reducing Wildfire Risks to Communities and the Environment: Ten-Year Comprehensive Strategy’’ was developed to implement the goals of the NFP in 2001 and subsequent legislation such as the Healthy Forest Initiative (HFI) and HFRA are designed, in part, to expedite and streamline the processes involved with carrying out this mission (Stephens and Ruth 2005).

2.2 Hazard Fuel Reduction and Bioenergy: Policies, Programs, and Potentialities

Over the course of the last half century, the United States has undergone a revolution in respect to the government’s approach to policy as well. Tools and instruments have been developed that act to effectively manage the public, government agencies, and other land managers (Schneider and Ingram 1990). While various

classification schemes exist, one simple method uses the terms sticks, carrots, and sermons as examples of some types of tools legislators can implement to affect land management behaviors (Schaaf and Broussard 2006). Sticks are coercive measures to influence management through restriction while carrots seek to modify practice through incentives or other financial assistance measures (Zhang and Flick 2001). Sermons on the other hand strive to emphasize a particular objective through public education or outreach programs (Schaaf and Broussard 2006). In recent years several regulatory policy sticks have emerged to influence landowner decisions such as zoning, urban growth boundaries, and land acquisition (Alavalapati et al. 2005). Some examples of carrots would be government cost-share programs for biomass removal, provision of conservation incentives, and tax exemptions for reducing hazardous fuels on private property. While a number of programs exist to educate and assist the public regarding wildfire risk and hazardous fuel mitigation, a substantial knowledge gap exists concerning program awareness and viability (Reams et al. 2005). In order for fire policy to be effective and sustainable, it must have the ability to respond to complex social, economic, and political forces (Stephens and Ruth 2005).

Hazardous fuel reduction policy has been, in recent years, a subject that has received a considerable amount of attention from government officials. In 2003**,** legislators signed the Healthy Forest Restoration Act into law. Cognizant of the need to reduce critical levels of accumulated hazardous fuels on forest lands, the HFRA is intended to decrease fuel loading, increase awareness of hazards associated with wildfire, protect communities and property located in the wildland-urban interface

(WUI) areas, and increase biomass usage that result from fuel treatment. Two principle methods for reducing accumulated biomass are prescribed burning and mechanical removal of woody debris. Mechanical removal is most often used by government agencies when the risks associated with conducting a prescribed fire are too great. The woody byproducts of mechanical thinning operations can have numerous uses, such as fencing and landscape materials, composite building materials, as part of liquid fuels such as biodiesel and ethanol, and for firing power plants or heating buildings (GAO 2005).

This strong linkage between the disciplines of biomass energy generation and fuel reduction led the DOE, USDI, and USDA to collaborate in an effort to achieve mutually beneficial goals for expanding the U.S. energy portfolio and utilizing mechanically removed woody biomass. Their recommendations were published in a memorandum of understanding (USDA/DOE/USDI 2003). The multi-agency efforts to bring about greater awareness and utilization of woody biomass do include outreach and educational agendas. The majority of the USDA's activities are carried out by the United States Forest Service (USFS) (GAO 2005). While the Woody Biomass Utilization Group has been established as a means of interagency coordination, agency officials prefer the use of informal means of communication to share information and ideas. Both the DOE and USDI have appointed officials to oversee and provide direction regarding woody biomass activities. While the USFS issued a woody biomass policy in 2005, no specific office or official has been appointed to oversee these activities and there is a risk that the activities carried out by this department will be negligible due to varying priorities

among units within the agency. The majority of USDA funding is utilized for the promotion of research, grants for biomass utilization and outreach programs, while the USDI's focus centers primarily on education. In addition to the USFS, two other USDA agencies participate in providing grants for renewable energy projects. These are the Cooperative State Research, Education, and Extension Service and USDA Rural Development. While biomass utilization projects can be funded by the programs these agencies offer, most of the projects addressed by these agencies fall under a category other than woody biomass (GAO 2005). The HFRA mandates that at least 50% of all hazardous fuels reduction projects will be conducted within the WUI, but leaves great latitude for the agency carrying out the operations to prioritize project locations (Davis 2004). Officials have cited two major obstacles to increasing the amount of woody biomass used: lack of reliable supply on federal lands, and cost effectiveness of biomass utilization (GAO 2005). In light of the fact that a majority of forestland in the Southeastern United States is privately owned and that the HFRA has made provisions for conducting hazardous fuel reduction operation on private lands that are at high risk for wildfire, recent research may hold some hope for alleviating the primary obstacles to biomass utilization.

A number of studies have been conducted recently in an attempt to determine the feasibility of utilizing woody biomass as an energy source. In 2004, experts from a variety of fields, such as timber industry professionals, government leaders, and university personnel, convened at a workshop designed to discuss the current state of biomass usage in the Southern United States. This workshop analyzed several

components of biomass utilization and identified key themes that were unanimously identified for all areas of research. The themes that the working group identified were marketing, infrastructure, community engagement, incentive support, collaboration, and education. These themes were identified as areas that may provide obstacles to expanding the use of forest-based bioenergy (Mayfield et al. 2007). A report by Gan (2007) determined that the Southeastern United States was the region that would be most likely to provide viable feedstock for generating electricity due to high degree of logging activity, ample and spatially compact biomass, and therefore, lower cost of transportation. He also stresses the need to integrate policy (hazardous fuel reduction, bioenergy, and timber harvest) and the practices associated with land management (Gan 2007). Other studies have shown that forest lands have the potential to play a major role in the future of the bioenergy portfolio (Gan and Smith 2006; Perlack et al. 2005). In some cases HFRA legislation is already working to improve community safety and attract bio-based businesses (Iversen and Van Demark 2006).

As demands on forest lands become more complex, it is essential that policy makers incorporate multi-functional policy tools in order to more effectively encompass the pool of stakeholders(Cubbage et al. 2007). While many measures have been taken in an attempt by the government to rectify the shortcomings of the century-long policy of suppression, the NFP currently allocates 70% of funding to fire suppression (Stephens and Ruth 2005). The HFRA does provide a framework for reduction of hazardous fuels and the utilization of residual biomass, but many feel that obstacles in marketing the resource, incomplete or disjointed policy, insufficient outreach programs, and lack of

central direction will lead to continued catastrophic loss due to wildfire (Davis 2004; GAO 2005; Mayfield et al. 2007; Stephens and Ruth 2005). With standardization of policy as a stated goal of Federal Fire Policy (USDI and USDA 1995), it is essential that more steps be taken to ensure that effective policies are implemented, hazardous fuel reduction policy and biomass utilization policy are complementary, and communities are educated and involved in the process of policy formation. In addition, it has been mentioned that for woody biomass to become viable for large scale energy production, policies that facilitate its usage, or the elimination of policies that hinder its usage, will be paramount (Gan 2007). Comprehensive web-based databases such as the Database of State Incentives for Renewables and Efficiency (DSIRE) and the National Wildfire Programs Database exist as potentially valuable resources for educating the public on what policies and programs exist. However, further examination is needed to determine the effectiveness of this type of resource (Reams et al. 2005). There are several approaches that need further research on this topic, but for the purposes of the proposed landowner survey, this review will look more closely into the findings of existing landowner surveys and attempt to identify areas of need related NIPF landowners.

2.3 NIPF Landowner Studies

Private forest landowners are an important component of the landowner profile in the Eastern United States. Of the 620 million acres designated as forests in the United States, nearly two-thirds of that is owned by non-government entities (Butler et al. 2004). The concept of private forestland ownership is one worthy of consideration,

especially in the southeast where much of the nation's valuable timber resources are located. These ecosystems provide a wide array of services both tangible and intangible to society and it is imperative for all stakeholders that policy makers understand the needs, attitudes, and opinions of the forest landowner in order to sculpt useful and pertinent legislation for private landowners. A major constituent of this private land ownership is non-industrial private forest landowners. Schaaf and Broussard (2006) state that 242 million acres of forestland in the United States are currently under NIPF ownership. According to Butler et al., this portion of the landowner profile experienced an 11% increase between 1993 and 2003. Persons owning NIPF land are heterogeneous demographically and own land for a wide variety of reasons including conservation, aesthetics, and economic gain through timber sales or other activity (Butler et al. 2004). In the Southern United States, National Woodland Owner Surveys (NWOS) conducted in 2002 and 2003, revealed that while NIPF land ownership has steadily increased, knowledge and utility of forest management practices is very low. In a region that spans from Texas in the west, east to Florida, and northward to Virginia, it was found that only 3% of landowners surveyed had written management plans in place. Furthermore, they found that a mere 16% of NIPF landowners had sought any type of management advice within the last five years. A positive correlation exists between land parcel size and management plan implementation and/or advising on this region (Butler et al. 2004).

Concurrent with the rising number of NIPF landowners in the southeast, the region has seen increased population densities and urbanization. Between 1982 and 1992, 6.5 million acres of land in the south were converted from rural to urban uses, and

on average, counties in the south experienced a 7.5% growth in population. This growth trend is expected to continue and to be exacerbated in decades to come. The ever broadening expanse of wildland-urban interface (WUI) areas represents influx not only of human ideas, but also of ideas, beliefs, and land use modifications that must be considered by policymakers when initiating new legislative measures (Macie and Hermansen 2002). Population growth also means a greater occurrence of wildfire. The National Interagency Fire Center reported that human-caused wildfire ignitions outnumber lightning induced fires nearly sixty to one and consume over seven times the number of acres in the south each year (NIFC 2006). While the NWOS and subsequent publications by the authors do shed light on the situation surrounding NIPF landowners, it is clear that more research is needed to evaluate effectively what specific areas are in need of immediate attention.

Measells et al. conducted an NIPF landowner survey in the Southern geographic region in 2002-2003. The survey was constructed to ascertain landowner usage of forestry related educational programs and to determine whether the assumption that many forest landowners were underserved by these programs was correct or not. To accomplish this, the authors document the implementation of a survey instrument that was derived by first convening three focus groups per state, which consisted of volunteer NIPF landowners and a common moderator. Output from these sessions in conjunction with expert opinion of the researchers was the foundation for development of the instrument. Surveys were conducted by mail. Six-thousand surveys were mailed (1500 per state) with an overall response rate of 30.7% (1689 responses) (Measells et al. 2005).

The conclusion is that a majority (75%) of NIPF landowners are underserved in large part due to landowners being unaware that these programs exist and that greater effort should be put forth by concerned parties to reach these landowners. In addition to these findings, it was determined that from a sociodemographic standpoint, there was statistically significant variation amongst persons of different ethnicities and levels of education in regards to program utility (Measells et al. 2005). This is of particular interest due to the great degree of ethnical variation in the landowner profile in the Southern states.

While African-Americans constitute a considerable portion of landowners in some areas of the south, many black landowners consider themselves underserved (Gan et al. 2003). In 2003, Gan et al. published a study entitled "African-American Forest Landowners in Alabama's Black Belt" utilizing a snowball sampling method to obtain participants in a study designed to obtain knowledge regarding African-American landowners. The study was administered across twelve black belt counties via face to face and mail surveys with 102 responses in person and 69 valid replies to the mail survey (Gan et al. 2003). While the study determined that black NIPF landowners have many characteristics in common with non-black landowners, the survey was limited to blacks residing in 12 Alabama counties and did not test for fire knowledge, awareness, and attitudes. Several recommendations of this research were noteworthy, including: program directors need to advertise program availability more effectively to black landowners; it may be more effective to disseminate information orally within this community; agencies should recognize that some landowners' lack of monetary and

educational capital renders them unable to participate even in cost-share programs, and probably most importantly, the authors recommended further study of this demographic sector. Another related paper (Gan et al. 2005) states the need to expand this type of research to other states to gain a more comprehensive view of the situation.

A series of executive summaries posted on the Joint Fire Science Program (JFSP) website shows the results of another survey conducted by Brunson, Schindler, and Toman (2002). These surveys were conducted over seven fire prone regions of the United States to provide land managers with accurate local information regarding public attitudes and perception of wildland fuel management practices. Results were analyzed across the regions to determine similarities and differences that may exist. Individual reports indicate that the public trusts government agencies to make good land management decisions, but assigned low marks for agency incorporation of public interests into the decision making process (Brunson et al. 2002). In a later publication, Brunson and Shindler argue against “one size fits all” legislation as it pertains to wildfire policy and hazardous fuel mitigation projects (Brunson and Shindler 2004).

CHAPTER III

METHODOLOGY

3.1 Landowner Survey

3.1.1 Survey Instrument Development

Survey development took place through a joint effort of researchers at Texas A&M University and U.S. Forest Service project members in Atlanta via teleconference and email between the spring and fall of 2006. The survey instrument was then forwarded to state forestry professionals in the five states for review. These professionals made suggestions as to what information they deemed pertinent for their state and the research team once again revised the questionnaire. By March 2007, the survey was completed and submitted to Texas A&M University's internal review board for approval. The IRB approved the survey and it was in its final form by May 2007.

The survey was developed to test landowner knowledge, attitude, opinion, and strategy regarding wildfire, prescribed burning, and biomass utilization. All distributed surveys were identical from one state to the next, with the exception of questions to determine knowledge and usage pertaining to state-specific wildfire policy and programs. In this way, response data across states and populations are easily and reliably quantifiable, while policy discrepancies among states are identifiable.

The questionnaire has several major components. The first section asks landowners about their previous experiences with wildfire and knowledge of state level

wildfire related programs. These state-level programs were obtained by accessing the National Wildfire Programs Database (http://www.wildfireprograms.usda.gov).

Through the review process conducted by state forestry officials, it was also suggested that the Firewise communities program be included in this section. Although this program is conducted on a national scale, the decision whether or not to utilize this resource rests with the community. Figure 1 identifies general categories of programs that were identified and listed for each state in the survey instrument. The second and most lengthy section of the questionnaire includes questions over landowner preferences in receiving information on wildfire, management practices and strategies, perceived role of state government, and a few questions regarding woody biomass utility and knowledge. The final section asks landowners to identify various demographic characteristics, management practices, peripheral but pertinent to, the scope of the research, and disturbances they may have endured.

Existing State Level Program Types Tested by Survey					
	Alabama	Florida	Georgia	Mississippi	South Carolina
NFP Projects			X		
Workshop	X	X	X	X	X
Educational Material (Internet)		X	X	X	X
Public Service Announcement	X			X	
Informative Pamphlet/Newsletter		X			X

Figure 1. Program type tested by state.

3.1.2 Survey Area

The twenty-one counties in five states that were used are identified in Table 1 below. The original counties selected for this survey were selected based on the following criteria: greater than 25% of the counties residents are African American, more than 33% of the county land use is forestland, and the county is located in a state where significant acreage burns each year. These criteria were set forth as part of the USDA grant, which funded this project.

Table 1. Survey counties and selection criteria.

Counties In Which Survey Data Was Collected		
Location	% Black	% Forest Cover
Alabama		
Montgomery	52.5	50
Pickens	42.4	81
Marengo	51.7	72
Florida		
Gadsden	57.1	77
Hamilton	37.7	74
Jefferson	38.3	75
Bradford	21.9	75
Gulf	17.4	56
Georgia		
Greene	44.4	80
Hancock	77.8	91
Taliaferro	60.3	87
Warren	59.5	84
Wilkes	43.1	76
Mississippi		
Adams	52.8	71
Claiborne	84.1	81
Copiah	51	77
Jefferson	86.5	79
Wilkinson	68.2	80
South Carolina		
Bamburg	62.3	69
Hampton	55.9	69
Allendale	71	94

Note: Bradford and Gulf counties in Florida were later additions and do not adhere to all of the original selection criteria. They were substituted for counties that would or could not supply the required landowner information.

3.1.3 Landowner Population and Survey Sample Selection

After a triage teleconference in March 2006, the process of collecting data from the county tax assessors commenced. An internet search on county data was conducted and the contact information for the tax assessors in each county was gathered. Cooperation in releasing the landowner data varied greatly between counties. Some counties were reluctant or non-cooperative in divulging information while others outsourced data collection to private corporations. Some county tax assessors were unable or unwilling to provide electronic databases and almost all these offices charged a fee for the information. It was very difficult to obtain landowner data from states of Alabama and Mississippi. Data for these states was obtained through a cooperative effort from Mississippi State University professor Ian Munn, and Auburn University professor Yaoqi Zhang. Electronic databases for all counties (with the exception of Bamburg, SC, Allendale, SC, and Hancock, GA) were delivered in the fall of 2006. The data from Alabama was from 1997 and therefore the source cautioned that this data might bear some inaccuracy. These data sets had a high degree of heterogeneity concerning their format, what information they included, and various codification schemes that needed to be cleaned up. Once this data had been cleaned up to include only landowner name, complete address, and number of forested acres, as well as deletion of entities other than NIPF landowners, each landowner was assigned a numerical identifier. Paper hardcopies were cleaned up by manual strikethrough of duplicate landowners, land trusts, corporations, landowners holding fewer than 10 acres, and in some cases non-forest

landowners from the list. In the remaining group, which consisted of eligible landowners, each name was assigned a corresponding numerical value.

Upon completing the preparation and homogenization of the databases, a population for the survey was determined. The totals for each county within a state were tallied together and a simple random sample of n=500 was drawn from each state using a random number generator program in SAS. For each number selected by the random generator, a corresponding number representing a landowner was identified and those persons were placed in a single database on the state scale. For those numbers that were selected from the hardcopy data, the corresponding number was located within the database and the pertinent landowner information was manually entered into that state's database. These five lists of 500 landowners were then saved as worksheets in a single excel database. The sample is weighted to represent more heavily those counties that have more forest landowners.

3.1.4 Survey Administration

Mailing of the surveys was handled by the universities' printing services and generally adhered to the Dillman method (Dillman 1978). The first mail out of the survey took place in early July of year, a postcard reminder was sent in late July and a second mailing to those who had not responded was done in August with a cut-off date for replies in mid October.

3.2 Data Entry and Analysis

Data entry was performed by the primary researcher in office. A survey key was developed to codify the data. Yes/No answers to questions were treated as binary data, with "0" corresponding to a "no" response, and "1" corresponding to a "yes" response. Questions containing a "don't know" answer were assigned a value of "2." Knowledge portions that allow multiple answers to a single question were treated as follows: "1" was assigned for a darkened or checked box that indicated knowledge or use of a particular practice or program, and "0" was assigned for all blank boxes on this type of question.

Analysis of data includes descriptive statistics of the variables outlined within the survey. In addition, logistic regression was used to determine correlation among variables. Binary logistic regression is a statistical method for describing the interrelationship between a dichotomous dependent variable and multiple independent variables. Logistic regression coefficients can be used to estimate the probability ratio of each independent variable. Additionally, normal distribution of data is not required for a logistic regression model (Hidalgo et al. 2008). A binary logit model can be written as

$$P_i = Pr[y_i = 1] = F(X'_i \beta)$$

where y is a binary variable taking the value of 0 or 1, X is a vector of independent variables, and β is a vector of regression coefficient associated with X.

Seven empirical linear logit models were estimated in this study. These models respectively link specific variables to landowner demographics, attitudes, management strategies, and other factors. Regression analysis was carried out initially using forward

conditional selection of variables in SPSS v.15, which entails step-wise inclusion and elimination of variables based on significance to the model. Additional variables were added to those based on research goals (race, gender, land use). The models were validated via the Wald test for significance of individual independent variable, the log likelihood ratio test for overall goodness-of-fit, and the percentage of correct prediction by the model.

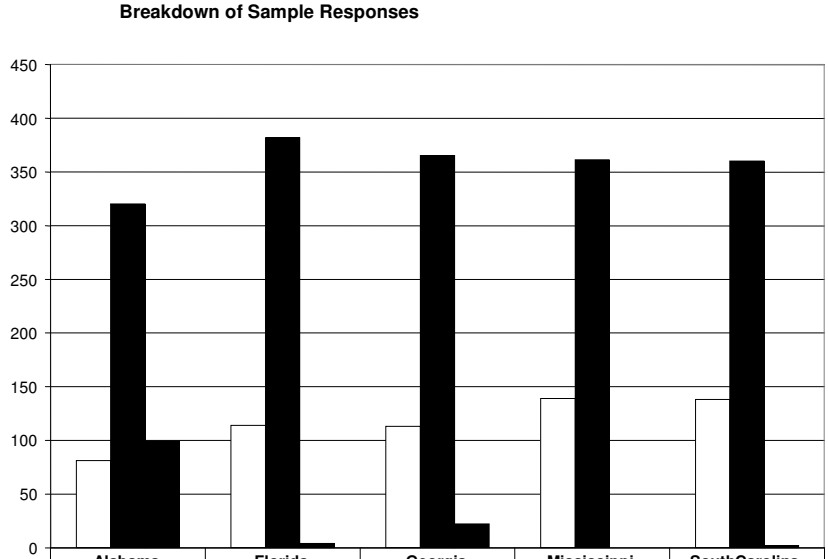
CHAPTER IV

RESULTS

4.1 Characteristics, Perceptions, and Management Behavior of the Respondents

4.1.1 Respondent Characteristics

Of the 2373 landowners who were contacted successfully, 585 landowners completed and returned the survey questionnaire, for a response rate of 24.7%. One hundred and nineteen addresses were determined to be invalid due to questionnaire and/or reminder being returned to sender, and eight replied they did not wish to fill out the survey. This led to 127 total omissions.



	Alabama	Florida	Georgia	Mississippi	SouthCarolina
Respondents	81	114	113	139	138
Valid Non-Participants	320	382	365	361	360
Bad Address or Refuse Participation	99	4	22	0	2

Figure 2. Breakdown of responses by state.

Of 581 respondents who answered the question regarding gender, 72.4 percent (n= 412) were male and 27.6 percent (n= 157) were female, providing an adequate basis for analyzing gender differences. Respondents indicated an average age of approximately 61 years with a range of 23 to 92 years of age. In terms of the racial composition of the respondents, 91.3% (n= 513) were white, 7.5% (n= 42) were black, and the remaining 1.2% (n= 7) were other ethnicities. Seventy-three percent (n= 402) had internet access. The median annual household income of respondents was between $70,000 and 90,000. Some 14.1% (n=69) earned less than $30,000, 13.1% (n=64) earned $30,000 – 49,999, 16.7% (n=82) earned $50,000 – 69,999, 12.9% (n=63) earned $70,000 – 89,999, 16.7% (n=82) earned $90,000 – 119,999, and 26.5% (n=130) earned $120,000 or more. A majority (69.1%, n=385) of respondents attended at least some college. Only 2.3% (n= 13) of respondents had achieved less than a high school education, so overall, NIPF landowners in this dataset are quite well educated. Respondent demographic data is shown in Table 2.

Table 2. Respondent demographic output.

Respondent Demographic Data for 2007 Landowner Survey				
Gender (%)			**Education (%)**	
Male (N=412)	72.4		Less than High School	2.3
Female (N=157)	27.6		High School Diploma or Equivalent	28.5
Race (%)			College or Technical School Graduate	39.7
White (N=513)	91.3		Higher than 4-year Degree	29.4
Black (N=42)	7.5		**Annual Income (%)**	
Other (N=7)	1.2		Less than 30,000	14.1
			30,000 - 49,999	13.1
Age (mean in years)	61.2		50,000 - 69,999	16.7
			70,000 - 89,999	12.9
Internet Access (%)	73		90,000 - 119,999	16.7
			Greater than 120,000	26.5

4.1.2 Land Management Activities, Landowner Preferences, and Disturbances

The following section covers responses given by landowners to survey questions regarding management activities on their rural property. Respondents were encouraged to check all answers that applied for a given question so potential for overlap may exist in some cases.

Analysis showed that while 88% (n=485) of respondents manage their land personally, only 51.5% (n=271) have a management plan for their property. Slightly more than half of the respondents (n=290) live on their rural property and 44 % (n=229) of these landowners classified their holdings as heirs property. While 38% (n=221) of those responding indicated that they were aware of at least one of the state-level fire prevention or education programs in their state, only 5.1% (n=29) of respondents were aware of any biomass utilization incentives programs that were available. When asked if they were interested in learning more about biomass utilization programs 66.2% (n=376) indicated yes, 20.1% (n=114) indicated unsure, and only 13.7% (n=78) said no, suggesting that while there may be limited knowledge of programs that are currently available, many landowners have a desire to learn more. See Figure 3 for a breakdown of the landowner management strategy and program awareness.

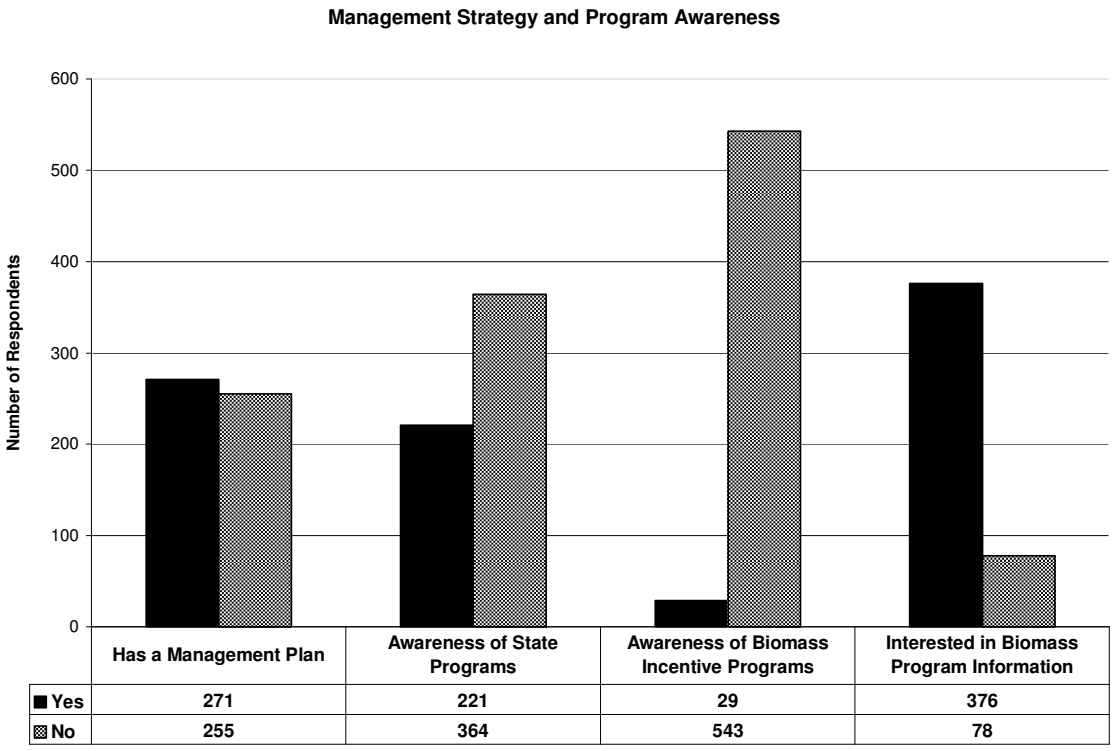


Figure 3. Landowner management strategy and program awareness.

Survey responses indicate that 24.6 % (n= 143) had experienced a wildfire on their property in the last ten years, 21.4% (n= 124) had lost property because of wildfire in the last ten years, and 92% (n= 516) believe that wildfire is a threat to their property. Analysis of responses regarding what the properties were used for suggested that timber production is a major utility with 70% (n= 397) of landowners managing for timber, 47% (n= 265) for recreation, 36% (n= 205) for farming, and 22% (n= 125) specified other uses which included cattle, residence, and nature among others. Figure 4 illustrates the landowner beliefs and experiences regarding wildfire.

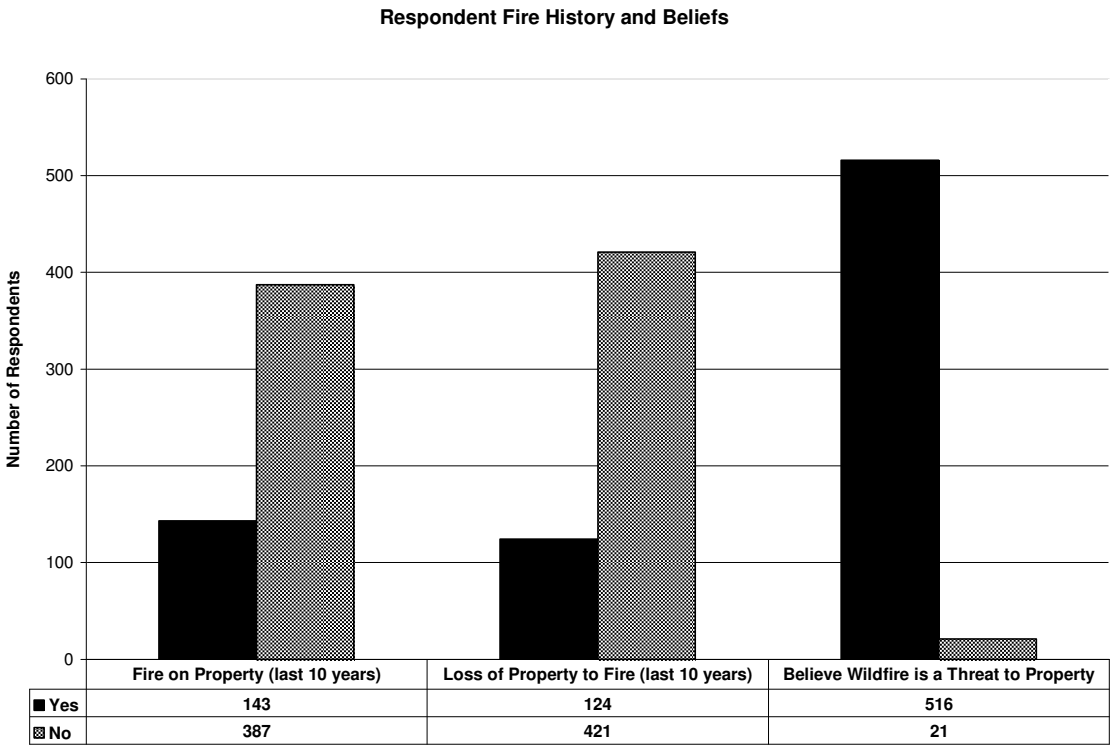


Figure 4. Landowner beliefs and experiences regarding wildfire.

Respondents were asked what measures they had taken to prevent wildfire. Analysis yielded the following information: 28.9% (n= 169) indicated that they had taken no action to prevent wildfire, 41.4% (n= 242) constructed fire lines; 9.4% (n= 55) purchased fire insurance, 37.4% (n= 219) removed or otherwise controlled excess growth of trees and shrubs, and 13.5% (n= 79) indicated they had used another method of fire prevention, most of which could be classified as a subgroup of above responses. Prescribed burning was the most popular selection listed under ‘other’.

Analysis of responses regarding whether disturbances that may promote wildfire had occurred on participants' property show that 40% (n=227) had experienced no disturbances. Beetles were the most frequent disturbance reported at 36.3% (n= 206), followed by hurricanes at 24.7% (n= 140). About 19% (n= 106) of landowners cited other disturbances which included tornadoes, strong winds, lightning, ice storms, droughts, and floods. Figure 5 compares the disturbances reported by landowners.

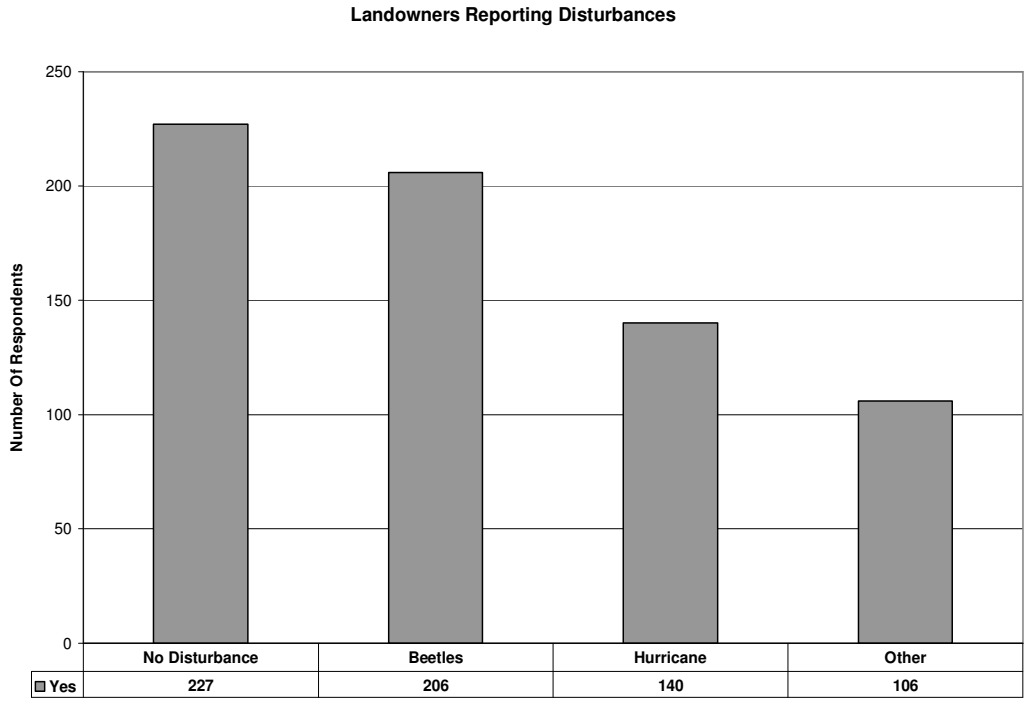


Figure 5. Disturbances reported by landowners.

Questionnaire responses indicate that 64% (n= 365) of participants have received information on wildfire prevention, while only 13% (n= 72) had actually made a request for information from a government agency. The survey offered seven choices/reasons for participants not having received any information. Their responses were as follows. 26.2% (n= 153) responded that they already know how to prevent wildfire on their land; 15.9% (n= 93) stated that they did not know who to contact to receive this information; 6% (n=35) said they were not concerned about wildfire on the property; 3.8% (n= 22) stated they did not manage their rural property at all; 42.2% (n= 247) stated they did not know that the information was available; 1.2% (n= 7) do not trust agencies providing the information; and 7.7% (n= 45) gave their reason as being other. The relatively low occurrence of requesting information from an agency thus breaks down into two major sub categories, those landowners who do not request information because they feel that they already have adequate knowledge regarding fire prevention and mitigation strategies, and those who either do not know that the information exists or do not know who to contact. Figure 6 shows landowners' reasons for not requesting this type of information.

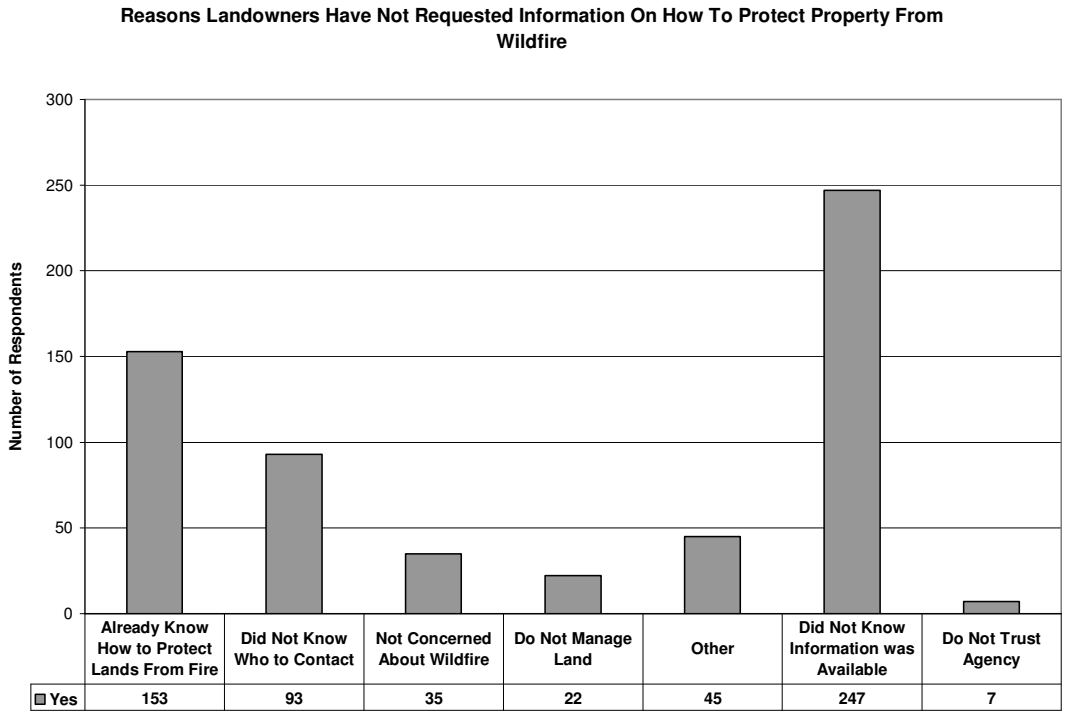


Figure 6. Landowner reasons for not requesting information.

When landowners were asked where they received their information, they responded that 25.3% (n=148) receive information from friends and family, 24.1% (n= 141) received information from state or county extension offices, 9.2% (n= 54) received information from a federal forest agency, 19.3% (n= 113) developed their own methods of fire prevention, 17.6% (n= 103) rely on their neighbors for information, 37.6% (n= 220) receive information from a state forest agency, and 5.8% (n= 34) utilize the internet to gain wildfire related information. Approximately, 13.5% (n= 79) indicated they used another method which included utilizing a professional forester or consulting firm.

When asked their preferred method of receiving information about wildfire prevention, 54.5% (n= 319) of the landowners prefer to receive information through conversation with a forestry professional, 23.1% (n= 135) prefer a workshop conducted by professionals, 36.1% (n= 211) prefer an informative pamphlet, 11.8% (n= 69) prefer to use the internet, and 3.9% (n= 23) selected other alternatives. Landowners' preferred methods of receiving information are compared in Figure 7.

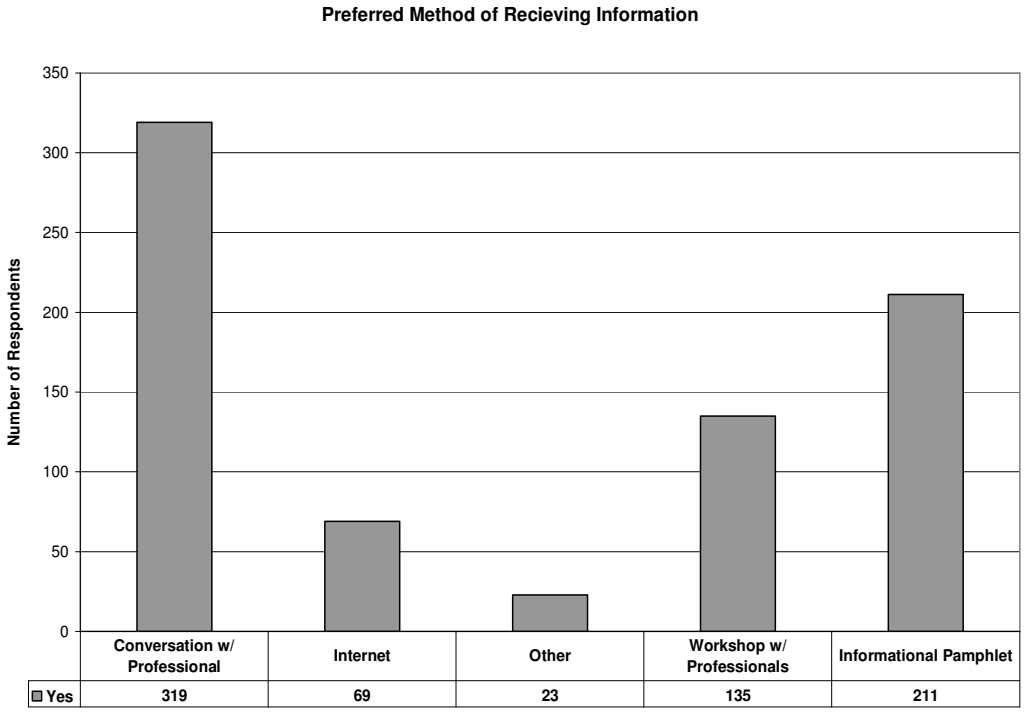


Figure 7. Landowner information preferences.

Participants were asked what they thought the role of their state government should be in reducing wildfire threats. More than 50% (n= 307) of the respondents indicated they would like the state to provide fire risk education, 30.1% (n= 176) would like the state to remove, burn, or otherwise control excess growth of trees and shrubs, 25.3% (n= 148) would like the state to provide low-cost fire insurance, and 13% (n= 76) prefer another form of state intervention which included on-site professional consultation, easing of burning regulations and improved support for the states fire suppression forces. Figure 8 illustrates landowners' belief about the role of the state in reducing wildfires.

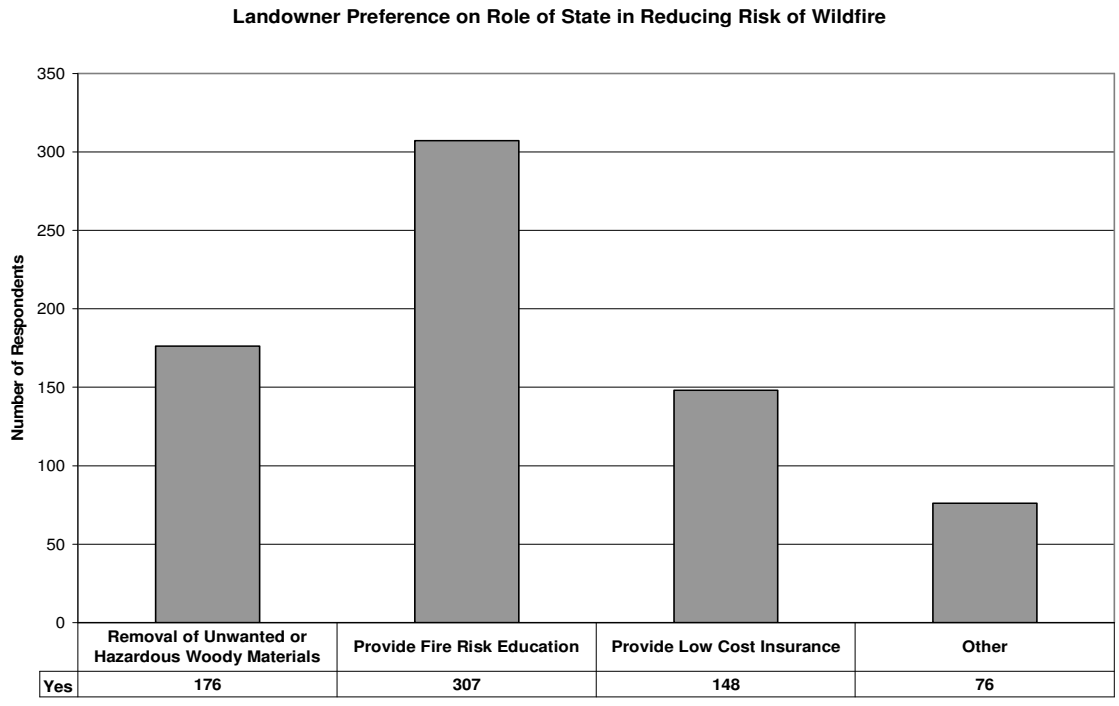


Figure 8. Role of the state.

When asked what measures could be taken at the state level to encourage fire prevention on the landowners rural property, almost 6% (n=33) selected no action as their preference, while 20.7% (n= 120) indicated a desire to receive technical assistance with removal of unwanted biomass. 37.9% (n=220) of them wanted the ability to sell removed biomass, 38.6% (n=224) desired participation in a state or federal cost-share program, and 1.5% (n= 9) indicated other measures on the questionnaire.

4.2 Logit Regression Results

In total seven models were constructed and estimated. Three models were designed to test a variety of factors that may explain landowner knowledge of various programs related to wildfire education, hazardous fuel mitigation, and biomass utilization within their state. The other four models test what factors may influence wildfire management/mitigation strategies. By using a forward conditional selection of variables in SPSS v.15, many variables were eliminated and a suitable basis for developing the models was achieved. Table 3 lists all variables that were used in at least one model, gives the corresponding question number, a variable description, and a key explaining how responses were coded. In addition to the variables selected using the forward conditional approach, other variables of interest such as gender, race, and management objectives may have been included if they were deemed relevant to a particular model. The models were validated using several statistical tests including the Wald test for significance of an individual variable and the log likelihood test for overall fit.

Table 3. Variable descriptions and measurements.

Question Number	Variable Name	Description	Response Key
1	**FirePres**	Fire present on property last 10 years	(1=Yes, 0=No)
3	**FireBel**	Believe fire threatens property	(1=Yes, 0=No)
4	**ProgAw**	Aware of fire policy or program in state	(1=Yes, 0=No)
9a	**NoreqKnow**	Have not requested information because they already know how to prevent fire on property	(1=Yes, 0=No)
9b	**NoreqCont**	Have not requested information because theydo not know who to contact	(1=Yes, 0=No)
9f	**NoreqInfo**	Have not requested information because they did not know this information was available	(1=Yes, 0=No)
10c	**GetInfoFed**	Get Information on fire prevention from federal forestry agency	(1=Yes, 0=No)
10d	**GetInfoOwn**	Develop their own fire prevention methods	(1=Yes, 0=No)
10f	**GetInfoState**	Get Information on fire prevention from state forestry agencies	(1=Yes, 0=No)
10g	**GetInfoNet**	Get Information on fire prevention from the internet	(1=Yes, 0=No)
11b	**InfoNet**	Prefer usin the internet for land management advice	(1=Yes, 0=No)
11d	**InfoWkShop**	Prefer professional workshop for land management advice	(1=Yes, 0=No)
13a	**PrevNone**	Have taken no action to prevent wildfire	(1=Yes, 0=No)
13b	**PrevFrLn**	Constructs fire lines to prevent wildfire	(1=Yes, 0=No)
13d	**PrevIns**	Purchases fire insurance to mitigate losses due to fire	(1=Yes, 0=No)
13e	**PrevRemBio**	Removes unwanted biomass to prevent fire on property	(1=Yes, 0=No)
14a	**RoleRem**	Think the role of the state should be biomass removal	(1=Yes, 0=No)
14b	**RoleEdu**	Think the role of the state should be fire education	(1=Yes, 0=No)
14d	**RoleIns**	Think the role of the state should be providing low-cost fire insurance	(1=Yes, 0=No)
15	**BioAW**	Aware of assistance or incentives programs that encourage biomass removal	(1=Yes, 0=No)
16	**BioInt**	Interested in learning about forest biomass and bioenergy production	(1=Yes, 0=No)
17a	**EncAsst**	Government provision of technical assistance would encourage fire prevention	(1=Yes, 0=No)
17b	**EncSell**	Ability to sell removed biomass would encourage fire prevention	(1=Yes, 0=No)
18	**Gen**	Gender	(0=Male, 1=Female)
20	**Race**	Race	(0=White, 1=Non-white)
21	**ManLand**	Personally manage rural land	(1=Yes, 0=No)
22	**LiveLand**	Lives on rural property	(1=Yes, 0=No)
24a	**ManTim**	Manage rural land for timber production	(1=Yes, 0=No)
24b	**ManRec**	Manage rural land for recreation	(1=Yes, 0=No)
24c	**ManFarm**	Manage rural land for farming	(1=Yes, 0=No)
25	**ManPlan**	Has a management plan	(1=Yes, 0=No)
27	**Edu**	Highest level of education completed	(0=Less than highschool, 1=High school graduate, 2= College or Tech school graduate, 3= Greater than 4 year degree)
30	**Inet**	Has Internet	(1=Yes, 0=No)

The result of logit regression in Table 4 shows that those landowners receiving information from state level forest agencies were 3.1 times more likely to have an awareness of programs that promote wildfire education or biomass removal in their state than those who had not received information from that source. Those receiving information from professional workshops were 1.8 times more likely to be aware of these programs than those who had not attended a workshop. Non-white landowners were 2.6 times more likely to have knowledge of these programs than white landowners were, while gender was not relevant. The existence of a management plan also bears a positive correlation to awareness. Interestingly fire prevention activities also showed correlation to program awareness possibly due to the fact that landowners already engaging in fire prevention are more involved or, conversely, prior enrollment in a program may have encouraged landowners to take preventative measures.

Table 4. Logit regression of landowners' awareness of state wildfire mitigation programs.

Dependent	Independent
ProgAw	(NoReqCont, GetInfoState, InfoWkShop, PrevFrLn, PrevRemBio, Gen, Race, ManLand, ManPlan)

Variable	Coefficient (Log-odds)	Exp(B) (Odds-ratio)	Wald	Sig
NoReqCont	-0.584	0.558	3.369	0.066
GetInfoState	1.144	3.138	26.884	.000
GetInfoWkShop	0.574	1.775	5.53	0.019
PrevFrLn	0.53	1.699	5.348	0.021
PrevRemBio	0.625	1.868	8.599	0.003
Gen	-0.119	0.887	0.229	0.632
Race	0.938	2.554	5.899	0.015
ManLand	-0.167	0.846	0.26	0.61
ManPlan	0.476	1.61	4.464	0.035
	Cases Included in Analysis	N = 502 (85.8%)		
	-2 Log Likelihood	559.616		
	Model Predicted Percentage Correct	71.90%		

As shown in Table 5, landowners that had experienced fire on their property in the previous ten years was not significant at the 5% significance level when asked if they perceived wildfire as a threat to their rural property. Gender, Race, and LiveLand variables were also found to have no significant correlation to landowners' perception of wildfire threat. Respondents who manage their land for timber were 6.8 times more likely to consider wildfire a threat than those who do not manage for timber. A higher level of education also increased the odds of believing wildfire poses a threat. Landowners who develop their own methods of fire prevention were less likely to believe wildfire threatens their property than those who do not develop methods for fire prevention.

Table 5. Logit regression of landowners' perception of wildfire threat.

Dependent	Independent
FireBel	(FirePres, InfoOwn, Gen, Race, LiveLand, ManTim, Edu.)

Variable	Coefficient (Log-odds)	Exp(B) (Odds-ratio)	Wald	Sig
FirePres	1.848	6.348	3.033	.082
InfoOwn	-1.710	.181	8.207	.004
Gen	.003	1.003	.000	.997
Race	.074	1.077	.000	.930
LiveLand	.827	2.287	2.302	.129
ManTim	1.910	6.753	10.726	.001
Edu	.852	2.344	6.443	.011
Cases Included in Analysis		N = 449 (76.8%)		
-2 Log Likelihood		119.326		
Model Predicted Percentage Correct		95.80%		

Table 6 shows that those landowners receiving information through professional workshops were about six times more likely to be interested in receiving information on forest biomass and bioenergy production than those who do not attend workshops. Technical assistance in reducing fire hazards and the ability to sell removed biomass as a means of encouraging participation in fire prevention activity both increased the likelihood of landowners' interest in biomass for energy production by more than three fold. Landowners who identified the role of the state in reducing the threat of wildfires as education were almost twice more likely to be interested in learning about biomass use than those who did not. Landowners managing for timber also showed a positive correlation while landowners engaged in farming were slightly less likely to be interested than those not engaged in farming.

Table 6. Logit regression of landowners' interest in biomass for energy production.

Dependent	Independent
BioInt	(FirePres, InfoWkShop, PrevRemBio, RoleEdu, EncAsst, EncSell, ManTim, ManFarm)

Variable	Coefficient (Log-odds)	Exp(B) (Odds-ratio)	Wald	Sig
FirePres	.605	1.831	2.810	.094
InfoWkShop	1.805	6.080	10.819	.001
PrevRemBio	.566	1.760	4.313	.071
RoleEdu	.643	1.902	4.226	.040
EncAsst	1.170	3.222	5.092	.024
EncSell	1.171	3.227	12.137	.000
ManTim	.648	1.912	4.313	.038
ManFarm	-.610	.544	4.060	.044
	Cases Included in Analysis	N = 403 (68.9%)		
	-2 Log Likelihood	298.974		
	Model Predicted Percentage Correct	84.40%		

Table 7 describes the factors that may be correlated to landowner's wildfire preventative action on their lands. An answer coded with "1" denotes that no action was taken and a "0" indicates that some action has been taken. Landowners who had not requested information from a government source because they did not know it was available were seven times more likely to take no action than those landowners who did know the information was available. The other significant variables in the equation bear a negative correlation to the dependent variable, or in other words, the likelihood for no action increases with a decrease in the independent variable. Landowners indicating that they had experienced fire on their property, had internet access, lived on their rural land, or had a management plan were less likely to take no action than those who had not. Interestingly landowners who believed the state should be responsible for the reduction of excess biomass were also less likely to take no action than those who indicated it was not the role of the state.

Table 8 describes the results for the model that determines variables that bear some correlation with landowners who practice fireline construction as a means of fire prevention or damage mitigation. Fire presence on the landowner's property in the previous 10 years increased the odds of constructing firelines by about four times. Those who had not requested information because they already knew how to protect against wildland fire on their property were nearly three times more likely to engage in fireline construction. The negative coefficient for the NoReqInfo variable indicates that there was a negative correlation between those stating they did not know program information was available, and the practice of constructing fireline. Those landowners receiving

information from a state forestry agency were 2.5 times more likely to construct firelines than those not receiving information from this source. Landowners with a management plan and landowners managing for timber were more likely to build firelines than those who did not. The result also indicates that males were more likely to participate in this activity than females, but race was independent, suggesting that there was no statistically significant difference among different racial backgrounds of landowners in terms of fireline construction.

Table 7. Logit regression of landowners' taking no wildfire prevention actions.

Dependent	Independent
PrevNone	(FirePres, FireBel, NoReqInfo, RoleRem, Gen, Race, LiveLand, ManPlan, ManTim, Inet)

Variable	Coefficient (Log-odds)	Exp(B) (Odds-ratio)	Wald	Sig
FirePres	-1.060	.346	10.169	.001
FireBel	.022	1.022	.001	.973
NoReqInfo	1.937	6.939	45.774	.000
RoleRem	-1.322	.267	15.648	.000
Gen	-.400	.671	1.634	.201
Race	-.157	.855	.101	.751
ManTim	-.234	.791	.533	.465
LiveLand	-.857	.424	9.358	.002
ManPlan	-1.187	.305	17.474	.000
Inet	-.809	.445	7.355	.007

Cases Included in Analysis	N = 446 (76.2%)
-2 Log Likelihood	388.286
Model Predicted Percentage Correct	79.80%

Table 8. Logit regression results on fire line construction.

Dependent	Independent
PrevFrLn	(FirePres, FireBel, NoReqKnow, NoreqInfo, InfoState, Gen, Race, LiveLand, ManPlan, ManTim)

Variable	Coefficient (Log-odds)	Exp(B) (Odds-ratio)	Wald	Sig
FirePres	1.339	3.815	21.537	.000
FireBel	-.177	.838	.086	.769
NoReqKnow	1.058	2.880	12.221	.000
NoReqInfo	-1.129	.323	16.110	.000
GetInfoState	.903	2.467	12.384	.000
Gen	-.732	.481	5.887	.015
Race	.070	1.072	.018	.893
ManTim	.741	2.097	5.497	.019
LiveLand	.082	1.086	.106	.745
ManPlan	.828	2.288	10.179	.001
	Cases Included in Analysis	N = 428 (73.2%)		
	-2 Log Likelihood	413.243		
	Model Predicted Percentage Correct	78.00%		

Table 9 indicates that landowners who received information from the internet were 3.5 times more likely to purchase fire insurance than those who got their information from another source. Those who feel that the role of the state in reducing fire hazard should be removal of excess growth were 2.6 times more likely to buy fire insurance than those who did not. One explanation for this may be that these landowners' properties are currently in poor condition regarding biomass accumulation. The costly nature of thinning operations or other mechanical biomass reduction could be prohibitive for these landowners, so the purchase of fire insurance provides a relatively low cost option for economic remuneration in the event that wildfire damages on their rural property. Those who selected that the role of the state should be "other" were 5.2 times more likely to have insurance than those who did not. Since the survey was

conducted during the summer months of 2007 when many states were enduring severe drought conditions, some states enacted burn bans. Some survey respondents mentioned easing of burn bans as a measure that would enable landowners to engage in prescribed burning, their preferred method of biomass removal. Another concern expressed by some landowners was that state fire suppression forces were poorly equipped or under-staffed. This perception of increased fire risk due to these factors may have led some landowners to purchase fire insurance as a safety valve to avoid economic loss in the event of a wildfire on their property. Landowners residing on their rural property were far more likely to own an insurance policy than those who did not. Surprisingly previous fire history, belief that fire could damage their property, race, gender, and management for timber were not relevant to the model.

Table 9. Logit regression result on landowners' purchase of fire insurance as a mitigation option.

Dependent	Independent
PrevIns	(FirePres, FireBel, GetInfoState, RoleRem, RoleOth, Gen, Race, LiveLand, ManTim)

Variable	Coefficient (Log-odds)	Exp(B) (Odds-ratio)	Wald	Sig
FirePres	.179	1.196	.180	.672
FireBel	.587	1.799	.277	.599
GetInfoNet	1.245	3.473	5.049	.025
RoleRem	.946	2.574	5.869	.015
RoleOth	1.652	5.220	17.591	.000
Gen	.385	1.469	.904	.342
Race	-.568	.567	.673	.412
LiveLand	1.501	4.486	10.554	.001
ManTim	-.218	.804	.273	.602
Cases Included in Analysis	N = 456 (77.9%)			
-2 Log Likelihood	203.193			
Model Predicted Percentage Correct	91.70%			

Table 10 shows the interrelation between the independent variables and the fire prevention activity of removing hazardous fuels from the landowner's property.

Table 10. Logit regression result on landowners' removal of biomass.

Dependent	Independent
PrevRemBio	(FirePres, FireBel, ProgAw, GetInfoFed, PrevIns, RoleEdu, BioAw, EncAsst, Gen, Race, LiveLand, ManPlan, ManTim)

Variable	Coefficient (Log-odds)	Exp(B) (Odds-ratio)	Wald	Sig
FirePres	-.262	.770	.895	.344
FireBel	-.286	.751	.238	.626
ProgAw	.712	2.038	8.324	.004
GetInfoFed	1.230	3.421	9.137	.003
PrevIns	1.769	5.865	15.904	.000
RoleEdu	.883	2.418	13.121	.000
BioAw	1.100	3.005	4.113	.043
EncAsst	-.894	.409	7.999	.005
Gen	.580	1.786	4.526	.033
Race	-.273	.761	.335	.563
LiveLand	.792	2.208	10.725	.001
ManTim	-.767	.465	6.874	.009
ManPlan	.978	2.660	13.434	.000

Cases Included in Analysis	N = 423 (72.3%)
-2 Log Likelihood	455.827
Model Predicted Percentage Correct	73.80%

Landowners who were aware of state fire programs or educational materials were two times more likely to participate in hazardous fuel reduction practices as those who did not and landowners who received information from a federal agency were 3.4 times more likely to participate in this activity than those who did not. Landowners who purchased fire insurance were 5.9 times more likely to engage in biomass removal than those who did not. The model indicates that female landowners were more likely to

participate in hazardous fuel reductions than were males by a factor of 1.8 times, and landowners with a management plan were 2.7 times more likely to participate in biomass reduction activities than those who did not have a management plan. Landowners with an awareness of biomass incentives programs were three times as likely to participate in fuels reductions as those who were not aware of programs. Landowners who felt that the role of the state was to educate the public about fire prevention were also more likely to participate in hazardous fuel reduction than those who did not. Landowners who managed for timber and those who felt that government technical assistance would encourage participation in fire prevention activities were slightly less likely to conduct hazardous fuel reduction than those who did not. Previous fire activity, belief that wildfire threatens property, and race were not significant factors to the model.

CHAPTER V

SUMMARY AND CONCLUSIONS

The objectives of this research were to determine what factors influence landowners' wildfire mitigation strategies and their awareness and education regarding programs associated with wildfire, biomass utilization, and hazardous fuel reduction programs. Accordingly, three specific hypotheses were tested using landowner survey data obtained from five selected states in the southern United States.

A vast majority of the landowners who responded to the survey felt that wildfire posed a significant risk to their property. More than half of these respondents tended to prefer to receive information on wildfire mitigation and avoidance through conversation with a professional, via informative pamphlets and workshops conducted by professionals also receiving high marks. While three out of four respondents have access to the internet, it remained an unpopular mechanism among participants for obtaining information regarding wildfire education and hazardous fuel mitigation. Over half of the landowners responded that they felt the role of the state in reducing wildfire hazards should be to educate the public, and the most popular sources from which information could be obtained were state forestry agencies and state or county extension offices. More than one third of those surveyed stated that they were unaware that many of the programs or educational resources existed, while only a small percentage cited not knowing whom to contact as a reason for not receiving information. Timber management was by far the most popular management objective among respondents.

H1: A majority of landowners indicated that they had received information regarding wildfire while only a small percentage claimed to have requested information. A higher level of academic achievement was positively correlated to perception of fire as a threat, as was timber management. This is important because an individual is unlikely to seek out programs for which they see no need. Those landowners receiving their information from a state level forestry agency were three times more likely to be aware of programs than those who did not, while attending a professional workshop also bore a positive relationship to program awareness. Interestingly, the model also indicated that non-white landowners were far more likely to know about wildfire programs in their states than were white landowners.

H2: Two thirds of landowners in the survey expressed interest in learning about biomass as a fuel, but only five percent were aware any biomass related programs in their state. Nearly forty percent of landowners indicated that the ability to sell removed biomass would encourage them to participate more actively in fire prevention activities, so lack of a market for residual biomass, whether it is real or perceived, may cause reduction of biomass on NIPF lands to be cost prohibitive. The regression model dedicated to this question concurred that there is correlation between landowners who are interested in learning more about biomass as a fuel source and the ability to sell removed biomass. This model also showed a strong positive correlation with landowners who participated in professional workshops as well as those landowners with higher academic

achievements being more likely to have an interest in knowing more about utilizing forest waste as a fuel source.

H3: Four logit models were constructed to test variables that were pertinent to this hypothesis and covered four landowner management activity choices: take no fire prevention action, construct firelines, purchase fire insurance, and remove excess biomass. Landowners who were unaware that programs and information were available to them were far less likely to take action to prevent or mitigate damage due to wildfire than were those who were aware of these programs. Landowners with a management plan, who reside on their property, or who have previously experienced a wildfire on their property were more likely to take some action than those had not. Management for timber increased the odds that a landowner would construct fireline and slightly decreased the chances of removing excess biomass, the latter possibly due to cost feasibility. Males were more likely than females to participate in fireline construction while females were slightly more likely than males to participate in biomass removal. Some degree of information was pertinent to all three prevention action actions. Those receiving information from state forestry agencies were more likely to construct firelines than those who do not, those receiving information from the internet were more likely to purchase insurance than those who do not, and those receiving information from a federal forestry agency were more likely to engage in biomass removal than those who do not. Landowners who had experienced wildfire in the past ten years were four times as likely to engage in fireline construction as those who had not.

Both regression models and descriptive statistics indicate that education about wildfire is an important factor to landowners and the decision making process concerning their rural lands. It is also apparent that education programs in the form of practical workshops, professional conversations, and informative pamphlets, are highly desirable forms of disseminating knowledge regarding wildfire safety and mitigation strategies. While the degree to which landowners are educated appears to be pertinent to their desire to know more about bioenergy, knowledge of programs that exist is very low. This may be due in part to ineffective marketing of programs, information being difficult to access, narrow scope of programs being limited either geographically or in magnitude, or a variety of other reasons. However, participants did clearly indicate a desire to gain further insights into this field. In most cases characteristics such as race and gender did not seem to play a major role in landowner management strategies, although further research with a more diversified sample may yield different results and is therefore encouraged. That said, analysis indicates that educational programs are beneficial and effective, and state agencies are the primary distributor of these programs. These agencies may consider further efforts to make these programs available to the public as a large segment of NIPF landowners do not know that this information is available.

Landowners managing their lands for timber appear to be more conscientious with regards to wildfire, more amiable to learning the utility of residual biomass, more likely to construct firelines, and less likely to remove excess biomass. This last factor may be explained by the large cost associated with mechanical hazardous fuel

reductions. Many landowners wrote in “control burn” when asked what they had done to prevent wildfire, so there may have been some ambiguity regarding this question.

In addition to education, a large percentage of landowners indicated that changes in government provisions and policy would encourage them to participate in wildfire mitigation practices. Marketability of removed biomass and cost-share programs were the most popular responses selected by landowners when asked what measures would encourage them to participate in wildfire prevention activities. This may imply that the perceived cost-benefit ratio is currently too high for NIPF landowners to undertake preventative actions. While further research is needed to determine feasibility of such measures, a shift in policy regarding biomass removal may be in order. Future wildfire and energy policy should take into consideration how these areas may be mutually beneficial. Potential exists for policy makers to enhance forest health, reduce the threat of catastrophic wildfire events, and further the goals of integrated policy with well-crafted legislation that would benefit landowners, the environment, and the general population. Federal monies allocated to wildfire prevention and landowner outreach programs may be better spent by distribution to the state agencies that are consulted more frequently on these issues.

LITERATURE CITED

Alavalapati, J.R.R., D.R. Carter, and D.H. Newman. 2005. Wildland-urban interface: Challenges and opportunities. *Forest Policy and Economics* 7(5):705-708.

Brunson, M.W., and B.A. Shindler. 2004. Geographic variation in social acceptability of wildland fuels management in the Western United States. *Society and Natural Resources* 17(8):661-678.

Brunson, M.W., B.A. Shindler, and E. Toman. 2002. Fire management in public forests and rangelands: Executive summary. Joint Fire Science Program Project Report. Oregon State University, Corvallis, OR. http://oregonstate.edu/~shindleb/jfsp/Executive_Summary.pdf (last accessed May 20, 2008).

Busenberg, G. 2004. Wildfire management in the United States: The evolution of a policy failure. *Review of Policy Research* 21(2):145.

Butler, B.J., E.C. Leatherberry, C. Best, M.A. Kilgore, R.N. Sampson, and K. Larson. 2004. America's family forest owners. *Journal of Forestry* 102(7): 4-14.

Cubbage, F., P. Harou, and E. Sills. 2007. Policy instruments to enhance multi-functional forest management. *Forest Policy and Economics* 9(7):833-851.

Dale, L. 2006. Wildfire policy and fire use on public lands in the United States. *Society and Natural Resources* 19(3):275.

Davis, J.B. 2004. Healthy forests initiative: unhealthy policy choices in forest and fire management. *Environmental Law* 34(1209):1-8.

Dillman, D.A. 1978. *Mail and telephone surveys: The total design method*. John Wiley and Sons: New York.

Gan, J. 2007. Supply of biomass, bioenergy, and carbon mitigation: Method and application. *Energy Policy* 35(12):6003-6009.

Gan, J., and C.T. Smith. 2006. A comparative analysis of woody biomass and coal for electricity generation under various CO2 emission reductions and taxes. *Biomass and* Bioenergy 30(4):296.

Gan, J.B., S.H. Kolison, and N.O. Tackie. 2003. African-American forestland owners in Alabama's black belt. *Journal of Forestry* 101(3):38-43.

Gan, J.B., O.O. Onianwa, J. Schelhas, G.C. Wheelock, and M.R. Dubois. 2005. Does race matter in landowners' participation in conservation incentive programs? *Society and Natural Resources* 18(5):431-445.

Healthty Forests Restoration Act (HFRA). 2006. Healthy Forests. http://www.healthyforests.gov/initiative/introduction.html (last accessed December 15, 2006).

Hidalgo, P.J., J.M. Marin, J. Quijada, and J.M. Moreira. 2008. A spatial distribution model of cork oak (Quercus suber) in southwestern Spain: A suitable tool for reforestation. *Forest Ecology and Management* 255(1):25-34.

Iversen, K., and R. Van Demark. 2006. Integrating fuel reduction management with local bioenergy operations and businesses--A community responsibility. *Biomass and Bioenergy* 30(4):304-307.

Macie, E.A., and L.A. Hermansen. 2002. *Human influences on forest ecosystems the southern wildland-urban interface assessment.* U.S. Dept. of Agriculture, Forest Service, Southern Research Station. Asheville, NC.

Mayfield, C.A., C.D. Foster, C.T. Smith, J. Gan, and S. Fox. 2007. Opportunities, barriers, and strategies for forest bioenergy and bio-based product development in the southern United States. *Biomass and Bioenergy* 31(9):631-637.

Measells, M.K., S.C. Grado, H.G. Hughes, M.A. Dunn, J. Idassi, and B. Zielinske. 2005. Nonindustrial private forest landowner characteristics and use of forestry services in four southern states: Results from a 2002-2003 mail survey. *Southern Journal of Applied Forestry* 29(4): 194-199.

National Interagency Fire Center (NIFC). 2006. *Fire information: Wildland fire statistics*. Bureau of Land Management, Office of Fire Management. Boise, ID. http://www.nifc.gov/fire_info/fire_stats.htm (last accessed January 10, 2007).

Perlack, R., L. Wright, A. Turhollow, R. Graham, B. Stokes, and W. Erbach. 2005. *Biomass as feedstock for a bioenergy and bioproducts industry: The technical feasibility of a billion-ton annual supply.* Oak Ridge National Laboratory. Oak Ridge, TN.

Reams, M.A., T.K. Haines, C.R. Renner, M.W. Wascom, and H. Kingre. 2005. Goals, obstacles and effective strategies of wildfire mitigation programs in the wildland-urban interface. *Forest Policy and Economics* 7(5):818-826.

Schaaf, K.A., and S.R. Broussard. 2006. Private forest policy tools: A national survey exploring the American public's perceptions and support. *Forest Policy and Economics* 9(4):316-334.

Schneider, A., and H. Ingram. 1990. Behavioral assumptions of policy tools. *Journal of Politics* 52(2):522-529.

Stephens, S.L., and L.W. Ruth. 2005. Federal forest-fire policy in the United States. *Ecological Applications* 15(2):532-542.

Sun, C. 2006. A roll call analysis of the Healthy Forests Restoration Act and constituent interests in fire policy. *Forest Policy and Economics* 9(2):126-138.

U.S. Department of Agriculture, U.S. Department of Energy, and U.S. Department of the Interior (USDA/DOE/USDI). 2003. *Memorandum of understanding on policy principles for woody biomass utilization for restoration and fuels treatment on forests, woodlands, and rangelands.* USDA/DOE/USDI. Washington, D.C.

U.S. Department of Agriculture and Department of the Interior (USDA/USDI). 2000. *Managing the impact of wildfires on communities and the environment: A report to the President in response to the wildfires of 2000.* USDA/USDI. Washington, D.C.

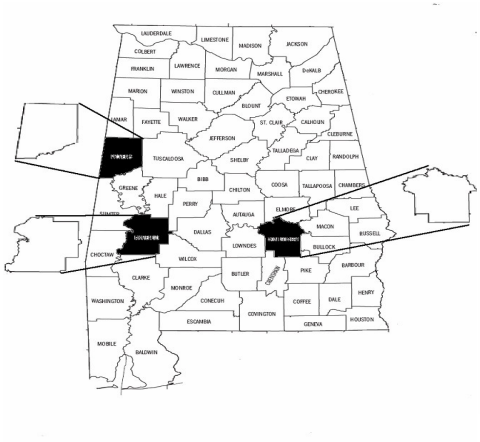
U.S. Department of Agriculture and Department of the Interior (USDA/USDI). 1995. *Federal wildland fire management policy and program review: Final report.* National Interagency Fire Center, Bureau of Land Management, Office of Fire Management. Boise, ID.

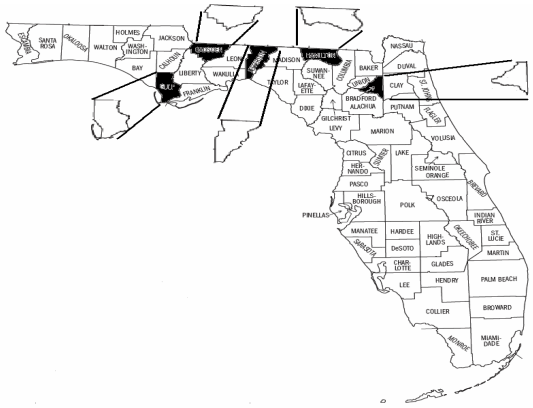
U.S. Government Accountability Office (GAO). 2005. *Natural resources: Federal agencies are engaged in various efforts to promote the utilization of woody biomass, but significant obstacles to its use remain.* Report to the Chairman, Committee on Resources, House of Representatives. U.S. Government Accountability Office. Washington, D.C.

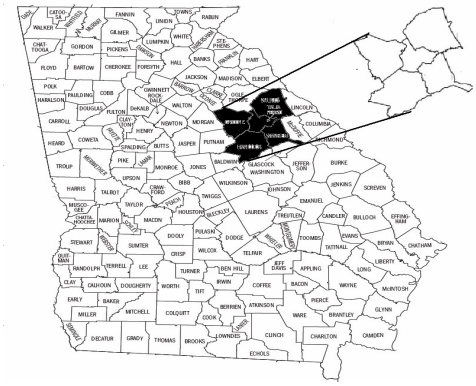
Zhang, D., and W.A. Flick. 2001. Sticks, carrots, and reforestation investment. Lan*d Economics* 77(3):443-456

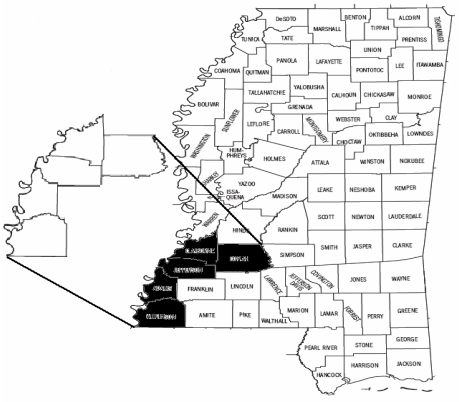
APPENDIX A

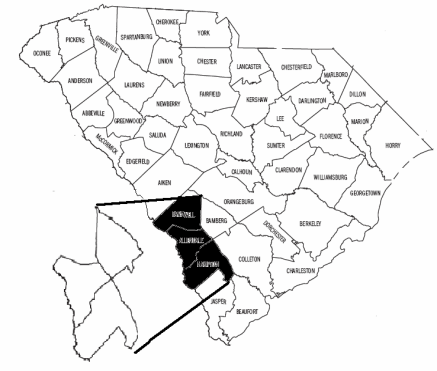
GEOGRAPHIC DISTRIBUTION OF COUNTIES











Sample of Survey Instrument

TEXAS A&M UNIVERSITY
College of Agriculture and Life Science
Department of Forest Science

College Station, Texas 77843-2135, USA http://forestry.tamu.edu

June 01, 2007

Dear Landowner:

Your household has been selected at random to participate in our survey. The purpose of this survey is gather information about wildfire awareness and rural land practices in southern states from the landowner perspective. The survey has been developed by and administered through Texas A and M University in College Station, Texas.

Your response will represent your community's opinion, so it is important that this survey be completed and returned; however, you have the right to decide not to complete the survey. We ask that the survey be completed by an adult in your home familiar with the management of your property and returned in the postage paid envelope provided.

The survey should take about 15 minutes to complete. The answers you provide will be anonymous and used only for research purposes by the project team. No data/information will be released that will leads to the identification of any individual or individual characteristics. If you have any questions about the survey or would like to obtain a report of survey findings, please contact us at the Department of Forest Science, Texas A&M University, College Station, TX 77843-2135.

Thank you very much for your cooperation.

Sincerely,

Jianbang Gan, Ph.D.
Investigator
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Adam Jarrett
Investigator
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Email: jarrett1@neo.tamu.edu

A. Wildfire Risk

We would like to ask some questions about wildfire in the Alabama county where you own land. Wildfire is an unplanned fire in a forested area. It can occur as an act of nature, for example: lightning strike, or be set by humans (arsonists).

1. Has wildfire ever burned on your rural land? ☐ Yes ☐ No ☐ Don't know

2. Have you or anyone you know lost property as a result of a wildfire within the past 10 years? ☐ Yes ☐ No ☐ Don't know

3. Do you believe your rural land could be damaged by wildfire? ☐ Yes ☐ No ☐ Don't know

B. Awareness of state programs and participation

4. The state of (**State Name**) provides information to the public on wildfire prevention through the Alabama Public Information Program and other agencies. The following table below lists existing wildfire prevention programs in your state. Please check "yes" in the last column of the table for each program if you are aware of it.

4 (Alabama)

Agency	Information	Yes
Alabama	Alabama WUI Councils	☐
	Alabama Wildfire Mitigation Program	☐
	Firewise Program: Teacher's Wildfire Prevention Workshops Firewise Community Workshop Firewise Radio and TV public service announcement	☐

4 (Florida)

Agency	Information	Yes
Florida Department of Community Affairs	Handbook: "Best Development Practices for Wildfire Mitigation in Florida"	☐
	Prevention: Firewise Communities	☐
	Internet: Florida Risk Assessment System Smoke Screening Tool Forestry Fire Management	☐ ☐ ☐
	Other: Fire in Florida's Ecosystem (for teachers) Living on the Edge in Florida (CD) Wildfire Risk Assessment Guide	☐ ☐ ☐
Florida Cooperative Extension Service	Landscaping with Florida in Mind	☐

4 (Georgia)

Agency	Information	Yes
Georgia	Georgia 2001 NFP Funded Mitigation Projects	☐
Georgia Forestry Commission	Firewise mobile exhibit	☐
	Internet video: Working Together for Safer Communities	☐
	Firewise Risk Assessment	☐

4 (Mississippi)

Agency	Information	Yes
Mississippi Forestry Commission	Internet: "The Role of Prescribed Burning in Managing Your Southern Pine Forest"	☐
	Firewise Program: Teacher's Wildfire Prevention Workshops Firewise Community Workshop Firewise Radio and TV public service announcement	☐

4 (South Carolina)

Agency	Information	Yes
South Carolina Forestry Commission	"Living on the edge in South Carolina" community workshop	☐
	Internet Fact Sheets:	
	"Fire and burning" information	☐
	"Firewise" information	☐
	"Protecting your home from wildfire"	☐
	"Your home in the line of fire"	☐
Other	"How to have a firewise home"	☐
	"Think before you burn"	☐

5. Have you ever received information about wildfire prevention from any state agencies? ☐ Yes ☐ No ☐ Don't know

6. If you have received information from a state agency, do you use this information to protect your land from wildfire? ☐ Yes ☐ No ☐ Don't know

7. If you have received information but do not use it, please tell use why not.

☐ It was not accurate. ☐ I have other ways of protecting my land from wildfire.

☐ I could not understand it. ☐ I intend to use it later.

☐ Other: (please specify) _____

8. Have you ever made a specific request to a state agency for wildfire prevention information? ☐ Yes ☐ No ☐ Don't know

9. If you have not requested wildfire prevention information, please tell us why not. Check all that apply.

☐ I already know how to protect my land from wildfire.

☐ I did not know who to contact.

☐ I am not concerned about wildfire burning on my land.

☐ I do not manage my land.

☐ I did not know this information was available.

☐ I do not trust the agencies providing the information.

☐ Other reasons: (specify)_____

10. Where do you usually get information about fire protection? Check all that apply.

☐ Friends or family ☐ Neighbors or other community members

☐ State or county extension agent ☐ State forestry agency

☐ Federal forestry agency ☐ Internet

☐ Develop own fire protection methods ☐ Other: (specify)_____

11. If you contact forestry professionals about managing your land, what kind of information is best for you? Check all that apply.

☐ Conversation with professionals ☐ Workshop hosted by professionals

☐ Internet ☐ Information pamphlet

☐ Other: (specify)_____

12. If you have a house or other building on your rural land, have you done any of the following to protect them from wildfire? Check all that apply.

☐ I have no house or other building on my land.

☐ I purchased extra hoses or fire extinguishers.

☐ I keep leaves, vines and shrubs cleared next to the house and out buildings.

☐ I keep trees, vines and shrubs cleared from around my home and outbuildings.

☐ I burn leaves, vines, and shrubs to keep them under control.

☐ I purchased extra property insurance.

☐ Other: (specify)_____

C. Fire prevention measures

13. What things have you done to prevent wildfire on your rural land? Check all that apply.

☐ None ☐ Buy fire insurance

☐ Construct fire line ☐ Remove unwanted trees or shrubs

☐ Other: (please specify)_____

14. What roles do you think the state of Alabama should play in reducing wildfire threats to your home, business, or other property. Check all that apply.

☐ Remove, burn or otherwise control excess growth of trees, shrubs, vines

☐ Provide fire risk education for home and business owners

☐ Provide low-cost insurance

☐ Other: (please specify)_____

Removing smaller trees and shrubs from forestland can help reduce wildfire risk. The removed trees and shrubs are called biomass and can be used to produce bioenergy (for example, bioelectricity and ethanol), which is useful to society.

15. Are you aware of any landowner assistance and incentive programs in your state that encourage biomass removal? ☐ Yes ☐ No

16. Would you be interested in learning more about forest biomass and bioenergy production? ☐ Yes ☐ No ☐ Don't know

17. If you have not taken any measure to prevent fire on your land, which of the following would encourage you to begin fire prevention practices?

☐ Technical assistance for fire protection ☐ State and/or federal cost-sharing for taking fire
☐ Ability to sell removed biomass from your land prevention measures
☐ None ☐ Other: (please specify)_____

D. Something about you and your forest

18. Are you: ☐ Male ☐ Female

19. What is your age? _____

20. What is your race or ethnicity?

☐ Black or African-American ☐ White
☐ Hispanic or Latino ☐ Native American
☐ Asian American ☐ Other

21. Do you personally manage your rural land? ☐ Yes ☐ No

22. Do you live on this land? ☐ Yes ☐ No

23. Is this land heir's property? ☐ Yes ☐ No

24. What do you use this land for?

☐ Timber ☐ Farming
☐ Recreation ☐ Other_____

25. Do you have a management plan for your rural land? ☐ Yes ☐ No

26. Has your rural land been hit by a natural disturbance(s)? Check all that apply.

☐ None ☐ Hurricane
☐ Beetles ☐ Other_____

27. What is the highest level of education you have completed? Please mark only one.

☐ Lower than high school ☐ High school graduate or equivalent
☐ College or technical school graduate ☐ Higher than 4-year college

28. What was your household income before taxes for 2005?

☐ Less than $30,000 ☐ $30,000 - 49,000
☐ $50,000 - 69,000 ☐ $70,000 - 89,000
☐ $90,000 - 111,999 ☐ $120,000 or more

29. About what percent of your household income is from your rural land? _____%

30. Do you have internet access? ☐ Yes ☐ No

Thank you for your time and assistance!

VITA

Adam R. Jarrett received his Bachelor of Science degree in urban forestry from Texas A&M University in 2005. He entered the Masters of Forestry program at Texas A&M University in January 2006. His research interests include forest policy, topics on bioenergy and agroforestry.

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